

COVID-19 Testing, Epidemic Features, Hospital Outcomes, and Household Prevalence, New York
State—March 2020

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Brief summary: We detail the extent of testing and positive results for COVID-19 during the month of March, 2020 in New York State, a focal point of the United States epidemic, and provide details on initial cases, including household prevalence.

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Abstract

Background The United States' COVID-19 epidemic has grown extensively since February 2020, with substantial associated hospitalizations and mortality; New York State (NYS) has emerged as the national epicenter. We report on the extent of testing and test results during the month of March in NYS, along with risk factors, outcomes, and household prevalence among initial cases subject to in-depth investigations.

Methods Specimen collection for COVID-19 testing was conducted in healthcare settings, community-based collection sites, and by home testing teams. Information on demographics, risk factors, and hospital outcomes of cases was obtained through epidemiological investigations and an electronic medical records match, and summarized descriptively. Active testing of initial case's households enabled estimation of household prevalence.

Results During March In NYS, outside of New York City, a total of 47,326 persons tested positive for SARS-CoV-2, out of 141,495 tests (33% test-positive), with the highest number of cases located in the metropolitan region counties. Among 229 initial cases diagnosed through March 12, by March 30 13% were hospitalized and 2% died. Testing conducted among 498 members of these case's households found prevalent infection among 57%; excluding first-reported cases 38%. In these homes, we found a significant age gradient in prevalence, from 23% among those <5 years to 68% among those ≥65 years ($p<.0001$).

Conclusions New York State faced a substantial and increasing COVID-19 outbreak during March 2020. The earliest cases had high levels of infection in their households and by the end of the month, the risks of hospitalization and death were high.

Key words: COVID-19, testing, surveillance, prevalence

Introduction

The Coronavirus Disease 2019 (COVID-19) emerged in Wuhan, China in December 2019 and was first diagnosed in the United States in Washington State on January 20, 2020 [1]. On March 2, the first non-travel associated case of COVID-19 in New York State (NYS) was diagnosed in Westchester County, adjacent to New York City (NYC). Following a March 7 declaration of emergency by the governor, which enhanced public health efforts by allowing expedited purchasing and an expanded testing protocol through multiple means, expanded access to testing was a priority in the NYS response effort [2]. By March 31, NYS had the largest number of cases in the United States: 47,326 laboratory-confirmed cases (NYC had over 58,000 additional cases and reports). Although national reports have tracked the progression of diagnoses reported by states to CDC, which are subject to delays and incompleteness, and some states have set up provisional online 'dashboards', no complete descriptions of diagnoses made in US states have been published [3]. Further, published US data on total number of tests are lacking, precluding understanding of the extent of screening and the test-positive percent, which describes the yield of testing in discovering new cases and is a critical statistic for informing epidemic trajectory.

Although in the majority of cases, COVID-19 causes mild illness, more severe illness has been associated with older age and comorbidities such as chronic obstructive pulmonary disease, diabetes, hypertension, and coronary heart disease [4, 5]. A recent analyses of severe outcomes among 4,226 COVID-19 cases described hospitalization among 12% of patients and ICU admissions among 2.9% of patients [5]. Few published studies exist on the distributions of demographics, comorbidities, and hospital outcomes, including deaths, in the US context, or those that exist have with high levels of missingness and have limited detail in each geographic setting, despite significant heterogeneity in the timing and magnitude of COVID-19 epidemics across US states [3, 5]. These outcomes are imperative for understanding healthcare burden due to COVID-19 and predicting future burden as the pandemic continues.

Person-to-person transmission of the SARS-CoV-2 virus, the virus that causes COVID-19, is primarily from close contact with an infected person and subsequent exposure to respiratory droplets [6]. Given this, households represent a particularly high-risk transmission environment, and accordingly quarantine recommendations call for the isolation of infected household members while others in the household undergo quarantine [7]. Data on the prevalence or incidence of COVID-19 among household contacts or the efficacy of such quarantine measures remain lacking, yet analyses of test-results at the household level can fill this gap [8].

In this report, we provide an overview of SARS-CoV-2 testing in NYS through March 31 and describe the demographics, risk-factors, symptoms, comorbidities, and hospital outcomes for the first 229 COVID-19 cases, from epidemiological investigations and hospital record-linkage. Using address-linked testing data we assess the prevalence of COVID-19 among household contacts of these cases.

Methods

SARS-CoV-2 testing became available in NYS in early March under FDA emergency use authorization at the Wadsworth Center, the New York State Department of Health's (NYSDOH) public health laboratory, and quickly expanded to other public health, commercial, and hospital clinical laboratories over the month. Throughout March, COVID-19 home testing teams and alternative specimen collection sites enhanced community testing, improving individuals' access to testing, and decreasing healthcare system burden. We tabulated daily totals of SARS-CoV-2 tests performed, the number of positive results, and the test-positive percent, as well as cumulative numbers of positive results by day and region.

During investigations by county health departments and NYSDOH staff, additional demographic, exposure risk factors, symptomology, comorbidities, and hospitalization outcomes were collected from interviews, medical providers, and medical records and entered into a

standardized case report form, based on CDC's form. We examined the first 229 reported cases from NYS, outside of NYC, from March 2 – March 12, 2020, which had relatively high investigation completion during this early portion of the outbreak. Cases were further matched against electronic medical record data from the Statewide Health Information Network for New York: a listing of all inpatients with suspected or confirmed COVID-19, including date of admission, date of discharge, and disposition (discharged alive, still in-hospital, died in-hospital), was available from all hospitals in NYC, Nassau County, Suffolk County, and all but one in Westchester County. We summarized data overall and by age group, performing Fisher's exact tests to assess key associations.

During this period, contact tracing and active case-finding was attempted by county and state health department staff, including for community members and household contacts of diagnosed persons. Beginning March 5, all household contacts, irrespective of symptoms, were eligible for home testing for SARS-CoV-2, performed by health department staff. Using data through March 17th, positive and negative laboratory COVID-19 test results were grouped into households, as follows. Two reviewers manually assigned household IDs to all unique addresses, determined by a manual review of all sorted street addresses, which was feasible given the limited extent of testing during this period. In the event of nearly-identical, but not exact, addresses, within a city, additional matches were made by correcting address errors and considering shared last names. We pooled persons across households to estimate overall COVID-19 prevalence among all households, including and excluding the first-reported case [9]. We compared pooled prevalence estimates by contact age and household, using χ^2 tests.

Results

As of March 31, in NYS, outside of NYC, 47,326 persons had tested positive for SARS-CoV-2 virus (Figures 1-2). By the end of the first week of March (March 7), 76 positive results were reported to NYSDOH. Positive results accrued daily to 1,083 by the end of the second week (March 14, 14.3-fold increase), to 12,691 (March 21, 11.7-fold), to 32,121 (March 28, 2.5-fold). Per Figure 2, cases emerged earliest in the New York Metropolitan Region and remained most numerous in those counties (top three counties: Nassau (17,678), Suffolk (15,272), Westchester (14,601)). During this period, a total of 141,495 tests were reported to NYS, from March 15–31, an average of 8,336 tests per day (range 2,428-10,714). During the latter half of March, with stable testing numbers, the statewide positivity rate continued to climb, increasing from a minimum of 11% to 48% at the end of the month.

Among the first 229 cases reported through March 12 the median age was 43 years (IQR: 24-56 years, range: 1-96 years) and 129 (56%) were male (Table 1). Travel-associated risk factors were lower (recent travel reported outside the US [9%] and outside NYS [21%]) than reporting contact with a confirmed case (79%). Sixteen percent were healthcare workers (HCW). Comorbidities were reported for 33 (30%) of 111 cases with completed comorbidity data and ranged from 0% among those <5 years to 67% among those ≥65 years ($p=0.0002$). Hypertension (39%), diabetes (29%), and asthma (23%) were the most commonly reported conditions. Symptoms of fever, cough, or shortness of breath were reported by 112 (76.0%) of 148 cases with completed symptom data, with lower levels of these symptoms reported by those <18 years versus those ≥18 years (25% [7/28] vs. 88% [105/119], $p<.0001$).

Of 112 cases with complete epidemiological investigation data on hospitalization status, 16% were reported hospitalized, ranging from no cases <18 years hospitalized to 44% of those ≥65 years ($p=0.004$). Separately, matching 201 cases who reside in Nassau, Suffolk, and Westchester Counties to electronic HIE records, we found 27 (13%) were hospitalized through March 30, with similar age patterns. Among those hospitalized, 56% were discharged alive after a median stay of 5 days, 30%

were still in-hospital as of March 30 with a median stay of 17.5 days (maximum 23 days), and 4 died in-hospital (2.0% of cases [exact 95% confidence interval: [0.5, 5.0] and 5% of those hospitalized). Two decedents were males ages 78 and 84, who respectively died after 11 and 8 days after admission, with the older patient having known comorbidities of diabetes and pulmonary tuberculosis. The two females were ages 76 and 82 years with no reported comorbidities, who respectively died 8 and 15 days after admission.

Molecular SARS-CoV-2 testing was conducted for 498 total persons in the households of the initial 229 cases (Table 2). COVID-19 prevalence was 57% (286/498); excluding the first-reported case per household yielded 131/343 (38%) infected household contacts. Among 103 households with ≥ 1 member(s) other than the initial case tested, 26 (25.2%) had all members test positive whereas in 40 (38.9%) households all tested negative. Among the 343 persons classified as household contacts of first-reported cases, 148 (43%) were tested on a different day after the first-reported case, at a mean of 3.7 days (SD = 2.9; median = 3, maximum = 10 days) later. Prevalence significantly increased with age, ranging from 23% among those aged <5 years to 68% among those 65 years or older ($p < 0.0001$).

Discussion

Our report illustrates the large extent of COVID-19 in NYS outside of NYC during March 2020, particularly in the counties closest to NYC, but also accruing over time in other counties statewide. New York currently has the most diagnoses in the United States, which reflects both a significant epidemic and a marked scaling up of testing during March, to over 100,000 tests performed [10]. The positivity rate of COVID-19 disease tests performed in the state continued to increase while the total number of tests was stable in the latter half of March. These data may suggest that testing for COVID-19 disease had increasingly been used as a diagnostic strategy in NYS over this time period with prioritization of testing for healthcare workers and hospitalized patients, which may result in underestimation of total prevalence [11]. Although testing approaches used early on and modeling

has been a primary method to estimate the number of non-hospitalized persons with COVID-19, other approaches such as seroprevalence studies should be considered as serologic tests are finalized, validated and become more widely available.

Males were over-represented among the first 229 cases observed in NYS at levels similar to but slightly lower than those reported in the outbreaks in China (58%) and Italy (60%) [12, 13]. The reasons for overrepresentation of males across different settings remain unclear, but this may be related to an increased likelihood of developing severe symptoms and presentation to care, although risk factors such as smoking have been proposed [14]. Travel histories reported by these cases are consistent with community transmission of SARS-CoV-2 [12, 15]. Our finding that 76% of cases experienced fever, cough, or shortness of breath is slightly lower than within the ranges reported elsewhere possibly reflecting more mildly-symptomatic cases identified through early case-finding efforts, but is higher than those found through extensive screening in a Seattle-area nursing home [13, 16, 17].

Among these first 229 cases the extent of hospitalization, ICU admissions, and intubation were all high. Hospitalization rates were similar to those in a recent national report, although this analysis provides additional information on age groups, intubation, and length of stay. Although the majority of hospitalized patients were discharged within a week, 30% remained hospitalized at a median of 17.5 days. The proportion admitted to the intensive care unit was higher in this sample, and may be due to higher levels of testing among more severely ill persons in the earliest phase of the NYS outbreak. The proportion of cases who had died (2%) is consistent with estimates observed in the US, although these estimates are subject to change over time [18].

Our finding that in households of cases over half of persons had COVID-19, align with a recent report from fewer households in Wuhan, China, and suggests substantial risk of transmission in this setting, although common sources cannot be ruled out [19]. These estimates can inform future follow-up studies to understand incidence in households and the effectiveness of and adherence to quarantine or other prevention strategies. We urge further action to develop and

deploy effective strategies for home quarantine and caring for those ill, particularly in the context of limited personal protective equipment. Although the observed age gradient in symptom development has been noted by others, this together with our finding of an analogous age gradient in prevalence may help to further explain why children are less represented in diagnosed persons, particularly those presenting for care [20].

Our results are subject to several limitations. Responses for demographics, risk factors, comorbidities, and hospital outcomes were each available for about half of cases, and for race/ethnicity specifically about one-quarter, and those with complete information may differ from those with missing information. These completion levels are substantially higher than the only previous US report and hospital outcomes align with that report and the more complete data from the HIE match [18]. Nonetheless, hospitalizations and deaths determined by that match may be lower-bound estimates, as cases may have attended hospitals outside the metropolitan NY catchment area represented in the HIE data and because more hospitalizations may accrue over time. Household prevalence results represent a period prevalence around the time of the first-diagnosed case in the home and it is possible ongoing transmission occurred afterwards. Further, given the use of RNA-only testing, it is possible some household members cleared their infection, possibly differentially by age, and prevalence may have been higher, although 43% were tested on the same day as the first case and half within 4 days.

NYS continues to be heavily impacted by COVID-19 and is implementing a variety of nonpharmaceutical interventions to control the disease, including school closures, restrictions on mass gatherings, remote work requirements for non-essential employees and other actions. Estimates in this report can be used to inform ongoing response efforts as well as other states' responses and parameterize models of epidemic extent and healthcare resources required to accommodate surge periods. Follow-up studies are underway to understand the spectrum of symptoms, illness, hospital utilization, and potential treatment approaches for persons with COVID-19 in NYS.

NOTES

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Table 1: Demographics, risk-factors, comorbidities, symptoms, and hospital outcomes for persons diagnosed with Coronavirus Disease 19 (COVID-19), New York State (excluding New York City), March 2 – March 12, 2020

<i>Demographics</i>	<i>%</i>	<i>(n)</i>
Sex		
Male	56.3	(129/229)
Female	43.7	(100/229)
Pregnant	5.9	(2/34)
Age (in years)		
0 – 4	28.6	(2/7)
5 – 17	43.2	(16/37)
18 – 29	22.2	(4/18)
30 – 49	45.6	(36/79)
50 – 64	49.2	(29/59)
65+	48.2	(13/27)
Race/ethnicity		
Hispanic	13.6	(8/59)
Black, non-Hispanic	6.8	(4/59)
White, non-Hispanic	69.5	(41/59)
Other	10.2	(6/59)
<i>Risk factors</i>	<i>%</i>	<i>(n)</i>
Travel outside US within 14 days	9.0	(11/122)
Travel outside NYS within 14 days	21	(25/119)
Contact with lab-confirmed case	78.9	(82/104)
Is Healthcare worker	16.2	(16/99)
<i>Comorbidities</i>	<i>%</i>	<i>(n)</i>
Any Comorbidity reported	29.7	(33/111)
Chronic Pulmonary Disease	9.7	(3/31)
Diabetes	29.0	(9/31)
Cardiac Disease	16.1	(5/31)
Immunocompromised	6.5	(2/31)
Hypertension	38.7	(12/31)
Asthma	22.6	(7/31)
Other comorbidity ¹	41.9	(13/31)
<i>Symptoms</i>	<i>%</i>	<i>(n)</i>
Any symptoms reported	82.6	(123/149)
Any fever, cough, shortness of breath	75.6	(112/148)
Fever	58.6	(85/145)
Cough	63.5	(92/145)
Shortness of breath	26.1	(31/119)
Other symptoms ²	62.7	(89/142)
<i>Hospital outcomes</i>	<i>%</i>	<i>(n)</i>
<i>Per epidemiological investigation³</i>		
% Hospitalized	16.1	(18/112)
Stayed in ICU	64.3	(9/14)
Required intubation	42.9	(6/14)
<i>Per Health Information Exchange⁴</i>		

% Hospitalized	13.4	(27/201)
<i>Disposition as of 3/30/2020</i>		
Discharged alive	55.6	(15/27)
Still in-hospital	29.6	(8/27)
Died in-hospital	14.8	(4/27)
<hr/>		
<i>Length of stay, by disposition</i>	<i>Median</i>	<i>(Q1, Q3, max)</i>
Discharged alive	5	(4, 7, 14)
Still in-hospital	17.5	(17, 18.5, 23)
Died in-hospital	9.5	(8, 13, 15)

1. Other comorbidities: Alzheimer's disease, Crohn's disease, dementia, heart defect, hypothyroidism, leukopenia, myasthenia, non-Hodgkin's lymphoma, pheochromocytoma, prediabetes, prostate cancer, and breast cancer.
2. Other symptoms: Abdominal pain, chills, diaphoresis, diarrhea, fatigue, headache, muscle ache, nausea, sneezing, stuffed or runny nose, and vomiting.
3. Based on findings from health department staff after the time of diagnosis, which may involve interviews with the case and healthcare providers, as well as examination of medical records.
4. Based on record-linkage with 2 large Regional Health Information Organizations, representing the electronic medical records for all of Long Island and New York City, and all but one hospital in Westchester County. This analysis is therefore limited to the 201/229 (88%) of cases reported from Nassau, Suffolk, and Westchester Counties.

Table 2. Prevalence of Coronavirus Disease 19 (COVID-19) in households of persons diagnosed in New York State (excluding New York City), March 2 – March 13, 2020

	All household members				All household members, excluding first-reported case			
	N	n	%	p-value	N	n	%	p-value
Overall (155 households)	498	286	57.4		343	131	38.2	
# of persons tested in household				0.10 ¹				0.065
One (52 households)	52	52	100.0		--	--	--	
Two (31 households)	62	44	71.0		31	13	41.9	
Three (15 households)	45	33	73.3		30	18	60.0	
Four (14 households)	56	28	50.0		42	14	33.3	
Five or more (43 households)	283	129	45.6		240	86	35.8	
Households >1 person	446	234	52.5	<0.001	343	131	38.2	0.002
0 to < 5 years	26	6	23.1		25	5	20.0	
5 to < 18 years	138	44	31.9		131	37	28.2	
18 to < 30 years	29	15	51.7		24	10	41.7	
30 to < 50 years	115	75	65.2		71	31	43.7	
50 to < 65 years	92	65	70.7		58	31	53.4	
65+ years	41	28	68.3		29	16	55.2	
Missing date of birth	5	1	20.0		5	1	20.0	

1. Test excludes the 52 households with one case person only

FIGURE LEGENDS

Figure 1: Testing for Coronavirus Disease 19 (COVID-19), New York State (excluding New York City), March 2020

Figure 2: Cumulative diagnoses of COVID-19 by county and week, New York State (excluding New York City), March 2020 ¹

1. We note several milestones in the expansion of testing, March 1: New York State (NYS) Wadsworth Center begins FDA-approved SARS-CoV-2 testing; March 5: increased testing of close and community contacts of cases via home testing; March 7: NYS governor emergency declaration expanded testing capacity; March 9: expanded testing criteria includes contacts of cases, travelers from affected counties, symptomatic persons in quarantine, symptomatic persons and not positive for another infection; March 13: beginning of community drive-through testing in most-affected counties.

Figure 1

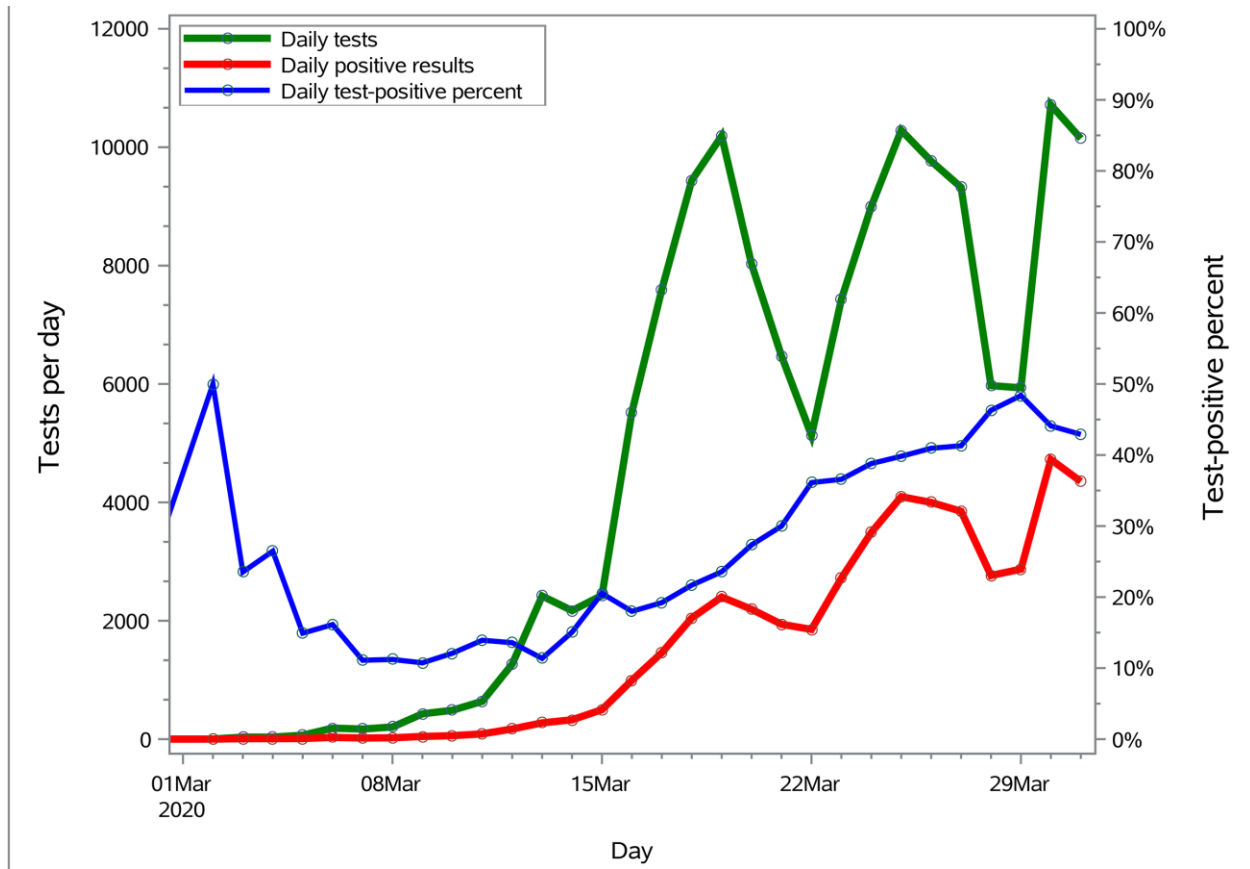


Figure 2

